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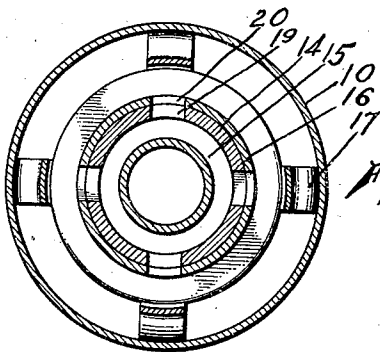
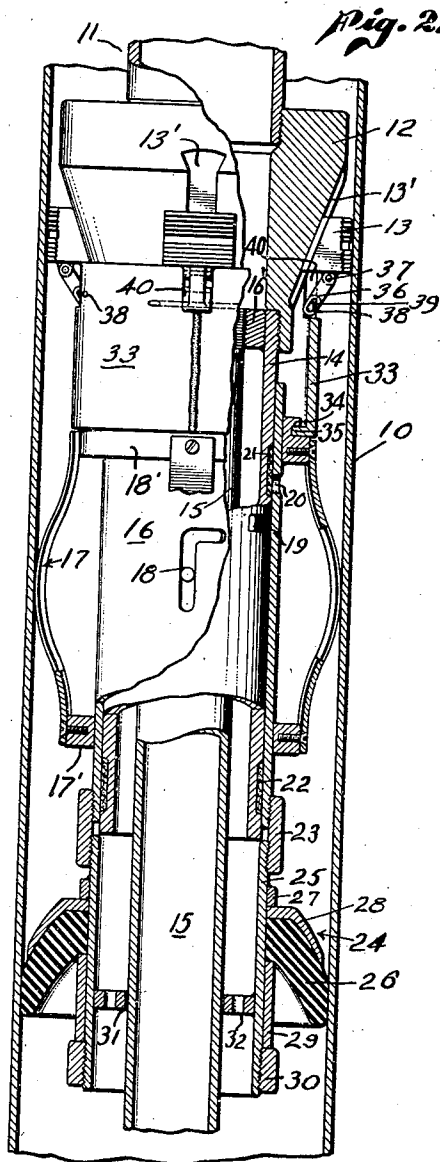
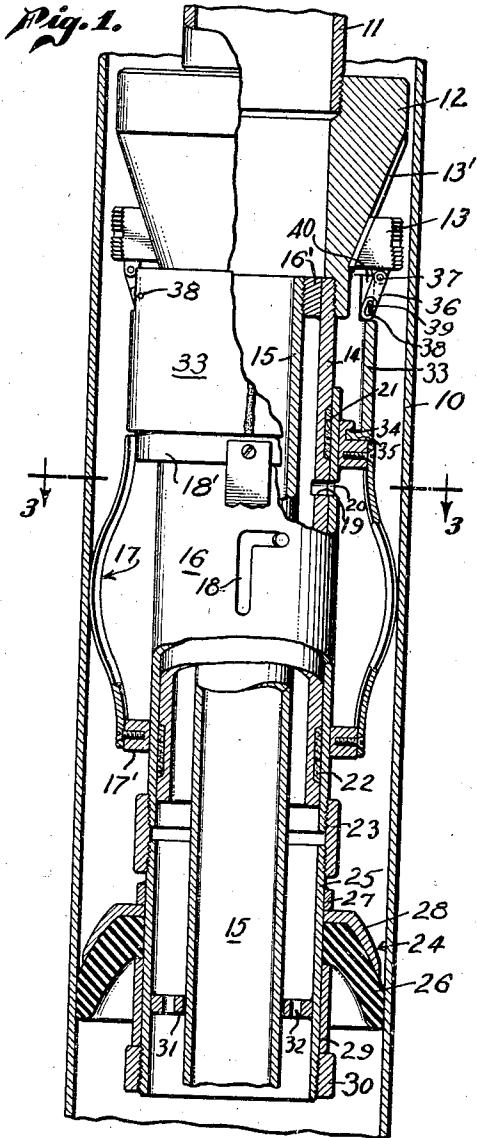
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2,390,112

WELL PACKER

Filed April 29, 1940

2 Sheets-Sheet 1



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Fig. 4.

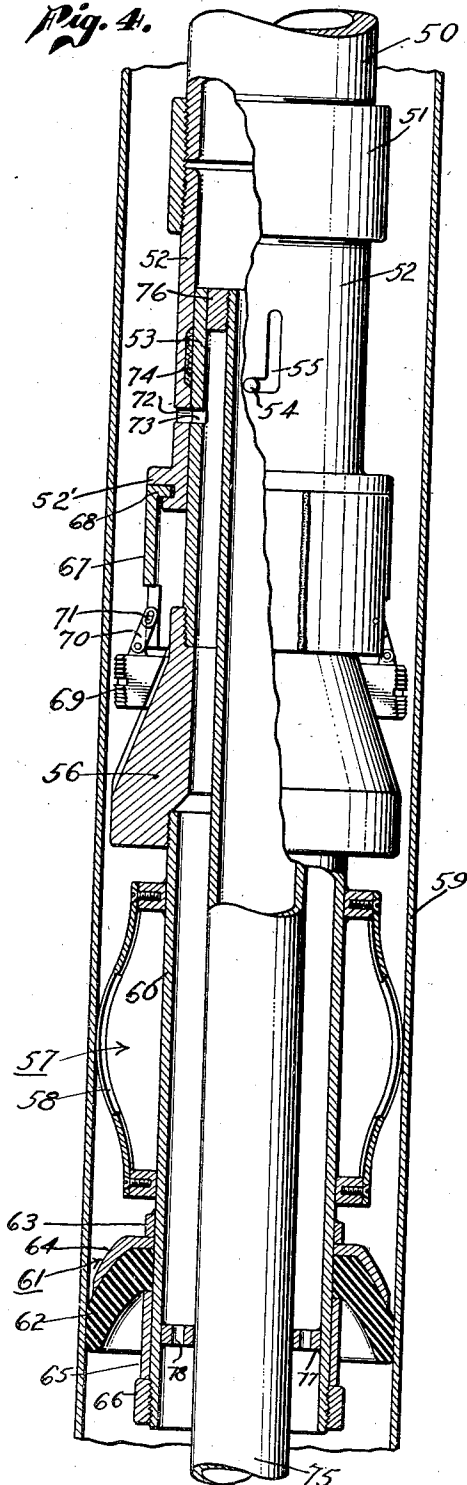
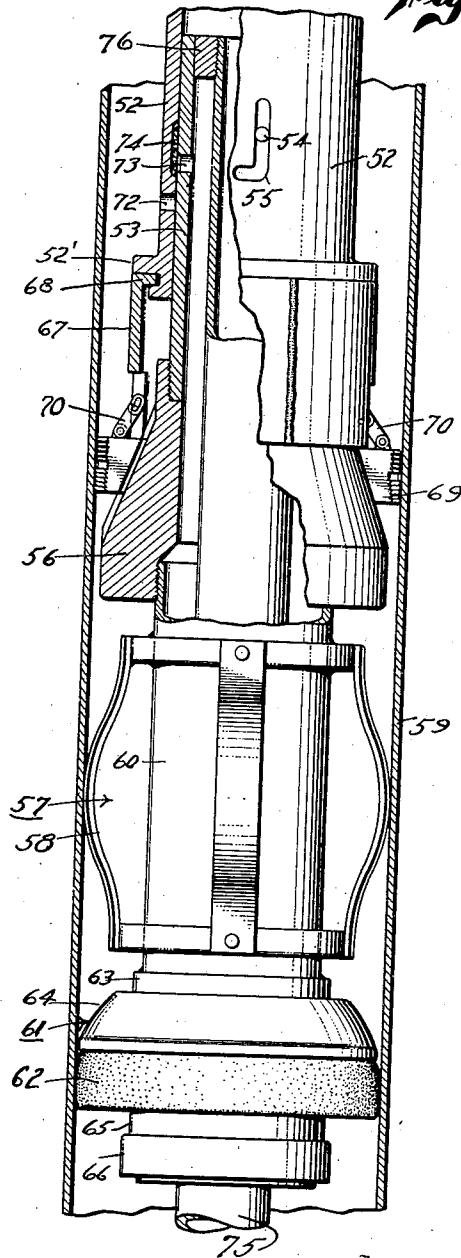


Fig. 5.



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WELL PACKER

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Application April 29, 1940, Serial No. 332,211

10 Claims. (Cl. 166—12)

This invention relates to tools for all uses in oil wells which require removable packers in the casing or lining.

Packers in oil wells, whether used for cementing and other development operations or for such production operations as bottom hole packing, setting the bottle hole bean, or other devices intended to withstand pressures from below, all depend upon the weight of the tubing carrying the packer or slip mechanism engaging the sides of the casing to maintain the packer in position. If the packer is equipped with ordinary slips to prevent downward movement the pressure from below has a tendency to force the packer upward, possibly kinking the tubing or even driving it out of the bore entirely. Attempts have been made to overcome this tendency by inverting the slips, giving, in effect, an updrive spear. This type of mechanism is efficacious in holding the packer down in the well against pressure tending to force it upwardly but has the very serious defect, if mudded up or clogged with cement, of refusing to lock out of engagement with the casing when the tubing carrying the slips is lowered to engage the J-lock. Under such circumstances, the packer may be driven downwardly but, as it is impossible to move it in an upward direction, it must be drilled out.

It is desirable to have a packer which may be lowered in the well or raised therefrom without the packer producing a swabbing effect on the casing, both to promote ease of insertion and removal, and to prevent a "wet job" while pulling the tubing.

It is, therefore, a primary object of this invention to provide a mechanism for securing a packer in a casing which will withstand pressure from below but which can be withdrawn from the casing with ease.

It is a further object of this invention to provide means for packing a well which can be inserted and withdrawn without interference caused by the well fluid.

It is a further object of this invention to provide bypass means in a packer which will automatically close upon the setting of the packer securing mechanism.

This invention possesses many other advantages, and has other objects which may be made more easily apparent from a consideration of several embodiments of the invention. For this purpose there are shown two forms in the drawings accompanying and forming part of the present specification. These forms will now be described in detail, illustrating the general principles of

the invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring now to the drawings illustrating embodiments of the invention.

Figures 1 and 2 show in elevation, partly in section, one form of the device in two different positions of operation.

Figure 3 is a cross section of Figure 1, taken along lines 3—3 thereof.

Figures 4 and 5 illustrate a second form of this invention in two positions of operation similar to those of Figures 1 and 2.

In the drawings, the casing 10 is within the well to be cemented. A tubing or drill pipe 11 is run into the well with the packing device attached thereto. This device, forming the subject matter of the present invention, consists of a slip head 12 attachable to the tubing 11, with slips 13 sliding in the slots 13' cut in the slip head, as is usual. This slip head is so shaped that downward movement of the head with respect to the slips engages the slips with the wall of the casing 10.

Below the slip head 12 and attached thereto is the tube 14, which extends downwardly therefrom. This tube contains a smaller tube 15, attached thereto, and so arranged that no fluid can flow in the annulus past the upper end of tube 15. This may be accomplished by simply providing a ring 16' secured to the outside of the small tube 15 and secured to the interior of tube 15. This small tube 15 may extend a considerable distance beyond the end of tube 14, as when the device is used to deposit cement.

Surrounding tube 14 is a sliding sleeve 16, equipped with a spring assembly 17 and a J-lock 18, the lock to hold the sleeve 16 down with respect to tube 14 when locked. This spring assembly is shown as of the usual form comprising a ring 18' fixed to sleeve 16, and a ring 17' slidable on sleeve 16. Rings 17' and 18' are connected by springs 17 adapted to frictionally engage the interior of casing 10. The drag of springs 17 tends to prevent axial or rotational movement of sleeve 16 with respect to casing 10, hence by appropriately moving tube 11 and connected parts it is possible to cause relative rotary or axial movement between sleeve 16 and tube 14.

Through the walls of tube 14 and the sleeve 16 are ports 19 and 20. As shown in Figure 1, these ports are in alignment when the J-lock is engaged to hold the sleeve 16 down with respect to

the tube 14. To render the ports effectual in shutting off flow, packing means 21 and 22 may be provided between the sleeve 16 and the tube 14. This packing has been shown as recessed in tube 14 but it is to be understood that it could equally well be in the sleeve 16. In such case, the upper packing 21 may be in such a position as to cover port 19 when the slip mechanism is set, in which case the lower packing 22 would not be necessary.

Attached to the lower end of sleeve 16 by coupling 23 is the packer assembly 24. This assembly may be of any suitable form, that illustrated being a tube 25 with a rubber or like packer 26 held thereon between a ring 27 and cup 28 on one side, and a ring 29 on the other side, ring 29 being held in place by ring 30 threaded on tube 25. Within tube 25 is secured the ring 31, which is ported at 32 and surrounds tube 15 so as to be movable with respect thereto. It is seen, with the above construction, that any movement of the tube 11 and the head 12 serves to move tubes 14 and 15 with respect to the packer and sleeve 16.

Attached to the upper end of the sleeve 16 is ring 33, which is arranged to move axially with sleeve 16 but is free to rotate with respect thereto. This may be accomplished in a number of ways, perhaps the simplest being the provision of a groove and inturned flange 34 and 35 formed on the sleeve 16 and the ring 33, respectively, the flange 35 fitting the groove 34 loosely enough to turn therein. For assembly purposes, the ring 33 may be split and welded in position with the flange 35 inserted in groove 34.

The upper end of the ring 33 is arranged to operate the slips 13. The particular mechanism by which this has been done is the provision of links 36 pivoted to the slips and ring 33 at 37 and 38, respectively. This mechanism together with ring 33 may be said to form abutment means between the sleeve 16 and the slips 13. Provision is made for some lost motion between the slips and ring by utilizing a slot 39 rather than a circular hole for one of the pivots in each link. The slips 13 and ring 33 abut each other upon downward movement of the slips 13 with respect to the ring 33. This can be conveniently accomplished by having the links 36 work in slots 40 in the ring 33, although any other method may be used.

In operation, the sleeve 16 is first locked in the position shown in Figure 1, which holds the slips out of engagement with the casing. In that position, the whole device can be lowered by the tubing 11 into the well, the fluid in the well passing up tube 25 to the annular space between tubes 14 and 15, and out of ports 19 and 20. At the same time, fluid passes up tube 15 into tube 11, thus obviating floating and entrapment of air in tube 11. When the lower end of tube 15 is near the bottom of the hole, wash water may be run in, which will displace the well fluid up through the annular space and out ports 19 and 20. As an alternative method of washing, water may be run down the annular space between the tube 11 and the casing 10 under pressure. When this is done, the water will pass packer 26 which is not effective to prevent flow in a downward direction, and the water will pass downwardly to the bottom of pipe 15 and thence up through pipe 15 and tubing 11 to the surface. Cement may then be run down the tube 11, and the assembly lifted as it runs in, until a sufficient amount has found its way through pipe 15 to the well. After the measured amount has been deposited, it is fol-

lowed by fluid or water, so that the final condition is a well with cement on the bottom and water or fluid in the tubing. The tubing 11 is then rotated to unlock J lock 18 and lowered, which sets the slips 13 in the casing and closes ports 19 and 20. If now pressure is applied to force the cement into the formation surrounding the casing, the upward pressure on the packer 26 serves to merely set the slips tighter, without lifting the slip head appreciably. The only downward force necessary on the slip head is to hold the slips in engagement with the casing, which is a very small force compared to the upward pressure on the packer.

After the cement has been presumably put away under pressure, it is desirable to clear the tubing of any excess cement. This can be done in either one of two ways. The slips can be locked down, thus opening ports 19 and 20, and fluid from the surface pumped down the tubing and circulated back up to the surface through ports 32, 19 and 20, and up through the annular space between tubing 11 and casing 10, or it can be accomplished by pumping fluid down through the annular space between tubing 11 and casing 10 and past the compressible packer 26 and up through the tubing 15 and 11 to the surface of the well. In case it is impossible to lock the slips down through failure of equipment or "mudding up" of same the latter method would have to be used. It will be noted that the ports 19 and 20 operate only upon operation of the slip setting mechanism, and that they are positively controlled by the position of the slip setting mechanism. This feature possesses several important advantages. It gives assurance that the ports will close when the slips are locked for squeezing, thus preventing inadvertent escape of cement into the space above the packer, which might clog the mechanism, and also assures that the assembly cannot be lowered unless the ports are open. This last prevents tearing of the packer, by pressures built up in the space below the packer, as the string of pipe or tubing is lowered. At the same time, failure of the ports to open upon upward movement of the string, due to failure of equipment, is not fatal to the success of the cementing job, and does not cause the loss of the packer in the well, as fluid can readily flow past the packer when the pressure above it is greater than that below it.

In Figures 4 and 5 a modified form of slip and packer assembly is shown. In this form, the slip head is attached to the packer to move therewith rather than to the tubing as in Figures 1 and 2. In this form, the tubing 50 is secured to the tool forming the subject matter of this invention by means of coupling 51 engaging a threaded portion of tubular member 52. This member 52 telescopes over the tube 53, which forms an inside sleeve with respect to tube 52. A J-lock comprised of a pin 54 secured to the outer surface of sleeve 53 and a slot 55 in tube 52 is provided so arranged that when locked the J-lock holds the outer tube 52 against downward movement with respect to the inner tube 53. Secured to tube 53 is a slip head 56 which may be secured by means of cooperating threaded portions on the slip head 56 and tube 53. This slip head 56 has a tapered outer surface so arranged that downward movement of the slips with respect to the slip head 56 or upward movement of the head with respect to the slips will cause engagement between the slips and the sides of the casing. Secured to the lower portion of the

slip head 56 is provided a friction spring and packer assembly 57. This assembly consists of springs 58 for engaging the side walls of the casing 59, these springs being mounted upon tube 60, which tube is fastened to the slip head 56. Also secured to tube 60 is a packer assembly 61 of usual form here illustrated as a rubber or like packer 62 held between a ring 63 and cup 64 on one side, ring 63 being welded to tube 60, and on the other side a ring 65 held in place by another ring 66 threaded to tube 60. It is, therefore, seen that the packer and spring assembly and the slip head 56 form one unit and any movement of the packer would be transmitted to the slip head 56.

Secured to tubular member 52 is a collar 67 so arranged that it will follow any axial movement of tubular member 52 but is free to turn with respect thereto. This is accomplished in the illustrated form by providing tubular member 52 with a recessed flange 52' in the recess of which the inturned flange 68 of collar 67 is free to turn. For ease of assembly, this collar 67 may be split and united by welding or the like after the flange 68 has been inserted in the recess in the flange 52' of tubular member 52. A series of slips 69 is secured to the collar 67 by means of links 70 pinned to the collar 67 and slips 69, respectively. The links 70 have provision for lost motion between the slips 69 and the collar 67 which may be readily accomplished by providing a slot for one of the pins securing the link 70 to the collar 67 and slips 69, here illustrated as slot 71 for the pin mounted on collar 67. Provision is made to allow the collar 67 upon downward movement to abut the upper surface of the slips which may be readily done by mounting the links 70 in slots in the collar 67 and permitting the bottom of the collar 67 to engage the surface of the slips 69, as shown in Figure 5. The wall of the tubular member 52 and wall of tube or sleeve 53 are provided with a pair of ports which coincide when the J-lock is locked in the position shown in Figure 4. These ports 72 and 73 permit passage of fluid from the interior of tube 53 to the exterior of the tool and provide bypass means for use during lowering or washing operations.

In order to prevent leakage of fluid through port 73 in sleeve 53 when ports 72 and 73 are in a position shown in Figure 5, a packing 74 is provided. This packing is arranged in such a position that when the ports are in a position shown in Figure 5 the soft packing material masks off port 73 and thereby effectually prevents the flow of fluid therethrough.

Within the tubing 53 and extending downwardly beyond the bottom of the tool is the wash pipe 75 which is secured in place by the annular ring 76 at the top thereof above ports 72 and 73. A second ring 77 secured in tube 60 near its lower end serves as a guide for tube 75 and is provided with ports 78 to permit passage of fluid through the annular space outside of tube 75 to ports 72 and 73.

The operation of this form is exactly as the form shown in Figures 1, 2, and 3, the parts co-operating in a very similar manner, the only difference being that motion of the tubing string 50 directly moves slips 69 rather than the slip head 56 when the tool is being engaged or disengaged from the walls of the casing 59. It is to be clearly understood that both forms of this invention shown may be used for other purposes than cementing of wells. For instance, as mentioned

before, the device is adapted to be used for any purpose in which it is desired to set a packer, and the essential feature of this invention consists of the novel cooperation between the slip assembly and the packers, whereby any pressure on the lower side of the packer tends not to lift the slip mechanism but to tighten the same. At the same time, it is not necessary to lock the slips out of engagement with the walls of the casing when withdrawing the tool therefrom, as mere upward movement of the tubing supporting the tool disengages the slips from the walls of the casing.

I claim:

1. A well cementing device including a tubing extending to the surface; a pair of spaced tubes one within the other, said tubes being connected to said tubing and extending therebelow; means preventing flow through the annular space between said tubes; a slip mechanism on the device; means operating the slip mechanism including a sleeve on the outer tube; a packer surrounding the sleeve and ports in the outer tube and the sleeve below said flow preventing means but above the packer, said ports being in registry when said slip mechanism is in inoperative position.

2. A well packing device including a tubular element adapted to communicate with the surface through a string of tubing, a slip mechanism operatively connected to said tubular element for gripping the walls of the well and preventing movement of said tubular element, operating means for said slip mechanism including a sleeve slidably mounted on said tubular element, and packing means mounted on said sleeve closing the annular space between said sleeve and the walls of the well, there being a port through said tubular element adapted to communicate with the exterior of said tubular element above said packing means, said sleeve operating to close said port upon setting of the slip mechanism.

3. A well packing device including a tubular element adapted to communicate with the surface through a string of tubing, a slip mechanism operatively connected to said tubular element for gripping the walls of the well, operating means for said slip mechanism including a sleeve slidably mounted on said tubular element, ports through said tubular element and said sleeve, said ports being in registry when said slip mechanism is in one position of operation and out of registry when said mechanism is in another position of operation, and a packing means mounted on said sleeve and closing the annular space between the sleeve and the walls of the well.

4. In a packing device for use in a well, said device including slip mechanism adapted to be operated to a position for restraining movement of said device in the well, slip operating mechanism including a slip head for moving the slips of said slip mechanism to and from casing engaging position and including a pair of tubular elements one mounted within the other, said elements being axially slidable with respect to each other, the slip head being connected to one of said elements, the slips being connected to the other element, whereby relative axial movement between the elements causes the slips to move laterally with respect to the casing, a packing element carried by one of said elements for sealing between said element and the casing, there being a pair of ports respectively in said tubular elements adapted to be in registry upon movement of said elements to a position to maintain the slips out of restraining position, and out of registry

when said elements are in position to maintain said slips in restraining position, and means forming a bypass around said packing element and including said ports, whereby the bypass is open when the slips are out of restraining position and closed when they are in restraining position.

5. A packing device adapted for use in a well casing and including a tube adapted for communication with the mouth of the well, a packer adapted to seal against the casing, means telescopically connected to said tube and mounting said packer for axial movement with respect to said tube, a slip head, said means mounting said slip head for movement axially of said tube, said means connecting said slip head with said packer for transmitting axial movement of the packer to the slip head, slips cooperating with the slip head to engage said casing upon downward movement of the slips relative to said head, and means operatively connecting said slips and said tube for transmitting axial movement of the tube to the slips to cause movement of the slips relative to the slip head.

6. A packing device adapted for use in a well casing and including a tube adapted for communication with the mouth of the well, a packer adapted to seal against the casing, a sleeve slidably mounting said packer on said tube for axial movement with respect thereto, a slip head mounted on the sleeve for axial movement with respect to the tube, slips cooperating with the slip head to engage said casing upon downward movement of said slips with respect to said head, and abutment means between said tube and said slips to transmit downward motion of the tube to the slips.

7. A packing device for wells and the like including a tube adapted for communication with the surface; a packer; means slidably connected to said tube mounting said packer for axial movement with respect to said tube when said packer is in sealing relation with the well casing; means forming a communication between said tube and the space below the packer; a slip head; means

mounting said slip head on said tube; slips cooperating with said slip head to grip the well casing and prevent downward movement of the tube; and an operative connection between the packer and the slips causing wedging of the slips between the slip head and the casing upon upward movement of the packer relative to the slip head under influence of the fluid pressure below the packer.

10. 8. A packing device for wells and the like comprising a tube adapted for communication with the surface of the well; a packer; a sleeve telescopically connected to said tube and mounting said packer for axial movement with respect to the tube; means forming communication between the tube and the space below the packer; a slip head; means mounting said slip head on the tube; slips cooperating with said slip head to grip the well casing and prevent downward movement of the tube; and abutment means connected between said sleeve and said slips to transmit the upward force of said packer generated by the fluid pressure below the packer to the slips to cause wedging of said slips between the slip head and the well casing.

30 9. A packing device for wells and the like including a tube adapted for communication with the surface; a ring and a sleeve; means mounting said ring and sleeve on said tube, said ring and sleeve being movable axially as a unit on said tube but rotatable with respect to each other; a packer mounted on the sleeve; a J-lock between the sleeve and the tube to lock said sleeve in a downward position; a slip head on said tube; slips cooperating with said slip head to wedge between the casing and the slip head to hold the tube against downward movement in the casing; and links connecting the ring to the slips.

40 10. A packing device as in claim 9 in which the sleeve carrying the packer carries resilient means engaging the casing and resisting motion of said sleeve with respect to the casing.

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